A Study on Seedlings' Density of *Aralia elata*

Man Shuhua （满淑华）　　Chi Changyi(迟长义)　　Liu Yanjun(刘延军)

Experimental Forest Farm of Liaoning Province, Qingyuan County 113300, Liaoning, P. R. China

Abstract　*Aralia elata* is an important economic species in northeast China. The experiments for determining optimum seedlings' density were made in the nursery of Experimental Forest Farm of Liaoning Province, Qingyuan County, in 1997. The results of 4 repeating experiments for six densities were analyzed using variance analysis by single factor. Seedling density has great effects on growth of diameter(at foot) and height. The proper seedlings' density for *Aralia elata* was determined to be 55~65 stems/m², or 330000~390000/hm². Thus density can insure individual seedling's quality and the maximum productivity of seedlings.

Key words: *Aralia elata*, Seedlings' density, Seedling's quality

Introduction

Aralia elata(Miq) seem is a leaf-losing small tree which belongs to Araliaceae Chines Aralia. It is one kind of medical and eatable plants. The tende shoot in early spring is valuable wild vegetables, which contains rich protein, fat, restored sugar, organic acid and much vitamin. It is one of main wild vegetables for export. However, this wild resource is coming to be exhauseted because of heavey gathering for years. Seeding and growing seedling experiment of *Aralia elata* was counducted from 1992 in order to protect this rare tree species. Seedlings' productivity per unit area is relative to seedling's quality and economic benifits of growing seedling. Experiments on determination of optimum seedlings' density of *Aralia elata* were made in 1997.

Methods

Natural conditions of the experimental nursery

Annual mean temperature of nursery(Qingyuan County, Liaoning Province) is 4.2 °C. The maximum temperature above zero is 32.1 °C. Annual mean rainfall is 700~800 mm, mostly in July and August. Frost-free period is about 125 days. The sandy soil contains N 34%, fast pand K 16.84%, organic materials 5.35%. pH value of the soil is 6.7.

Experimental method

We made four duplicates in 6 density levels by single factor. The six density levels are relatively 210000, 270000, 330000, 390000, 450000, 510000 seedlings per hectare. The experiments ranks as sequence. Each experimental plot is 6 m². The Experimental area for each density is 24 m². The seeling bed is 15 cm high and 50 m long.

Investigation method

When all seedlings grow out, we set up experiment plot by mechanic method. A sample squre of 1 m² was set up in each plot. The area of sample squres takes up 17 percent of the total area. We measured the height and mean diameter of seedlings in autumn when seedlings growth stopped. The length of principal root and number of rice root of standard individual seedling were measured according to mean hight and root diameter of seedlings.

Result and Analysis

Effect of seedling densities on seedling growth

Different seedling densities have great effects on growth of root diameter. The root diameter decreases with density's increasing. But the hieght growth increases with density's increasing when the seedlings' number is less 390000 per hectare. Over that density, the height growth decreases with density decreasing. Root's growth decreases with density's increasing (Table 1).

Table 1. Effects of seedling density on seedling growth of *Aralia elata*.

Seedling density (stem/hm²)	Foot diameter (cm)	Seedling height (cm)	Principal root length (cm)	Number of rice-root
210000	0.87	26.85	40.5	10
270000	0.85	29.98	38.6	11
330000	0.84	31.08	39.3	9
390000	0.80	32.78	38.2	9
450000	0.68	20.45	32.5	6
510000	0.63	17.78	30.8	5

From variance analysis(Table 2 and 3), we can see

seedling density have obvious effect on growth of diameter at foot and height.

Table 2. Variance analysis table of diameter at foot

Resource	Freedom degree	Squre sum	Variance	Ratio of variance	F value 0.01	0.05
density	5	0.18525	0.03707	17.65**	4.65	2.90
duplicate	3	0.01163	0.00388	1.85	5.42	3.29
random erro	15	0.03142	0.00210			
sum	23	0.22840				

Table 3. Variance analysis table of seedling height

Resource	Freedom degree	Squre sum	Variance	Ratio of variance	F value 0.01	0.05
density	5	740.92	148.18	5.44**	4.56	2.90
duplicate	3	165.63	55.21	2.02	5.42	3.29
random erro	15	626.28	27.23			
sum	23	1532.83				

In order to furtherly analyze growth difference of seedlings among each density, we made a comparison of mean difference value between diameter at foot and height by using minimal obvious difference(Table 4 and 5). There exists significant difference in growth of diameter at foot between the densities under 390000 individuals per hectare and over 390000. There exsits significant difference in height growth between the densities 390000 and 450000 stems per hectare.

Table 4. The test of the minimal significant difference for diameter at foot

Seedling density (stem/hm²)	Mean diameter at foot	Difference comparison of mean value 0.87	0.85	0.84	0.80	0.68
210000	0.87					
270000	0.85	0.02				
330000	0.84	0.03	0.01			
390000	0.80	0.07*	0.05	0.04		
450000	0.68	0.19**	0.17**	0.16**	0.12**	
510000	0.63	0.24**	0.22**	0.21**	0.17**	0.05

Table 5. The test of minimal significant difference of seedling height

Seedling density (stem)/hm²	Mean height of seedling	Difference comparison of mean value 32.78	31.08	29.98	26.85	20.45
210000	32.78					
270000	31.08	1.70				
330000	29.98	2.80	1.10			
390000	26.85	5.93	4.23	3.13		
450000	20.45	12.33*	10.63*	9.53	6.40	
510000	17.78	15.00**	13.30*	12.20*	9.07	2.67

Effect of different densities of seedling on seedling's quality

The practicaly surveyed seedlings were classified into three grades based on Seedling Quality Criterior of *Aralia elata* of Qingyuan County. The comparisons for quality of diameter at foot and and for quality of seedling height by different seedling densities were made(see Table 6 and 7).

Table 6. Comparison of quality of diameter at foot by different seedling densities

Seedling density (stem/hm²)	Grade I (%) >0.70cm	Grade II (%) 0.55-069 cm	Grade III (%) <0.54 cm
210000	72.0	18.0	10.0
270000	68.8	15.6	15.6
330000	57.9	26.3	15.8
390000	52.8	29.0	18.2
450000	31.0	33.6	35.4
510000	23.0	37.0	40.0

Table 6. Comparison of quality of seedling height by different seedling densities

Seedling density (stem/hm²)	Grade I (%) >20 cm	Grade II (%) 10-19 cm	Grade III (%) <10 cm
210000	69.2	12.8	18.0
270000	56.2	18.8	25.0
330000	73.6	13.2	13.2
390000	68.6	18.4	13.0
450000	41.2	11.7	47.1
510000	40.0	30.0	30.0

The percentage of qualified seedlings of grade I and Grade II for growth of diameter at foot decreases with density's increasing. The percentage of qualified seedlings of grade I and Grade II for growth of seedling height increases with density's increasing under or equal to 390000 stems/ hm².

Conclusion

The analysis indicated that the suitable seedling density of *Aralia elata* is 55-65 stems/m², or 330000~390000 stems/hm². With this density, the individual seedling quality can be insured and the maximum seedlings can be obtained.

Refernces

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